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developing observations in system
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(Discussion paper no. 46)

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Discussion Paper NO. 40
**CAUSE-EFFECT ANALYSIS
FOR DEVELOPING OBSERVATIONS
IN SYSTEM AUDITS**

by

A.F. Bishai

April 1985

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CAUSE-EFFECT ANALYSIS FOR DEVELOPING OBSERVATIONS IN SYSTEM AUDITS

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Introduction

The objective of this paper is to provide an outline for an approach to cause-effect analysis for developing observations in systems audits.

By using the example of the General Purpose Accommodation Program of DPW, this paper demonstrates how cause-effect relationships could be identified.

The tool used is a matrix, which we found to be convenient for the purposes of this analysis. The focus is on the approach rather than on the logic as the logic is always a matter of professional, and intellectual, judgement.

Construction and Use of a Matrix

Figures 1 and 2 show the structure of the matrix. Matters of significance to Parliament, in terms of economy, efficiency, effectiveness and reporting, are listed across the top. On the vertical column, we would list all the key controls we expect to see in the system. These may relate either to the management process or to the decision process. The relationships between matters of significance and management or decision processes are identified at the intersection of these columns. These relationships are identified by asking the question:

What could happen if a certain control is weak or non-existent?

The matrix is started at the same time as we chart the system and develop logic models. Although the matrix helps in building the logic models, it cannot be completed without them since they provide the vertical axis information.

Conversely, the matrix helps in defining matters of significance. It achieves this by forcing the auditor to decide on matters of significance at an early stage of the audit.

While the example of acquisition of capital assets is used, the approach is also suitable, subject to appropriate modifications, to other situations. For example, the models could be applied to identifying waste in an operation processing application caused by:

- poor communication with client groups;
- poorly designed forms; or
- inadequately trained public servants.

To illustrate the use of the matrix, let us assume that the auditor of DPW has the following hypotheses:

RELATIONSHIP OF MATTERS OF SIGNIFICANCE TO MANAGEMENT PROCESS

Management Control Functions	Possible Adverse Effects						
	Excessive Cost-Asset	Excessive Cost-O&M	Over-Estimated Revenue	Unauthorized Expenditures	User Need Not Met	Other Projects Affected	Incomplete Reporting To Parliament
● Demand Forecast	X	X	X		X		
● Option Definition and Analysis	X	X	X		X		
● Treasury Board	X	X	X	X			
● Design and Construction	X	X	X	X	X		
● Building Administration		X	X	X	X		
● Operations/ Maintenance		X		X	X		

RELATIONSHIP OF MATTERS OF SIGNIFICANCE
TO MANAGEMENT PROCESS

Management Control Functions	Possible Adverse Effects					
	Excessive Cost-Asset	Excessive Cost-O&M	Over-Estimated Revenue	Unauthorized Expenditures	User Need Not Met	Other Projects Affected
● Revenue Collection					X	Incomplete Reporting To Parliament
● Service Demand Analysis					X	
● Evaluation of Completed Project						X
● Reporting to Parliament						X

The Structure of a Matrix

- Purposes
- Objectives
- Goals
- Effects
- Consequences
- End
- Economy, Efficiency, Effectiveness
- Objectives of Control
- Matters of Significance
- Targets

		1	2	3	4	5
Means						
Causes (Direct/Indirect)	A					
Conditions						
System	B					
Management Process						
Management/ Decision Process	C			Relationship		
Controls						
	D					
	E					

- (a) Resource utilization is not economical.
 - excessive cost of asset;
 - excessive cost of operations and maintenance.
- (b) Organizational products/services are not effective.
 - user needs are not met;
 - overestimated revenue.
- (c) Inefficiencies in resource utilization.
 - excessive cost of asset;
 - excessive cost of operations and maintenance.
- (d) Irregularity
 - unauthorized expenditures;
 - other projects may be adversely affected;
 - inadequate reporting to Parliament.

These hypotheses are listed in the matrix as shown in Figure 1. The structure of the matrix is shown in the general model (Figure 2). The management control functions are taken from the logic model (Figure 3) and listed in the matrix.

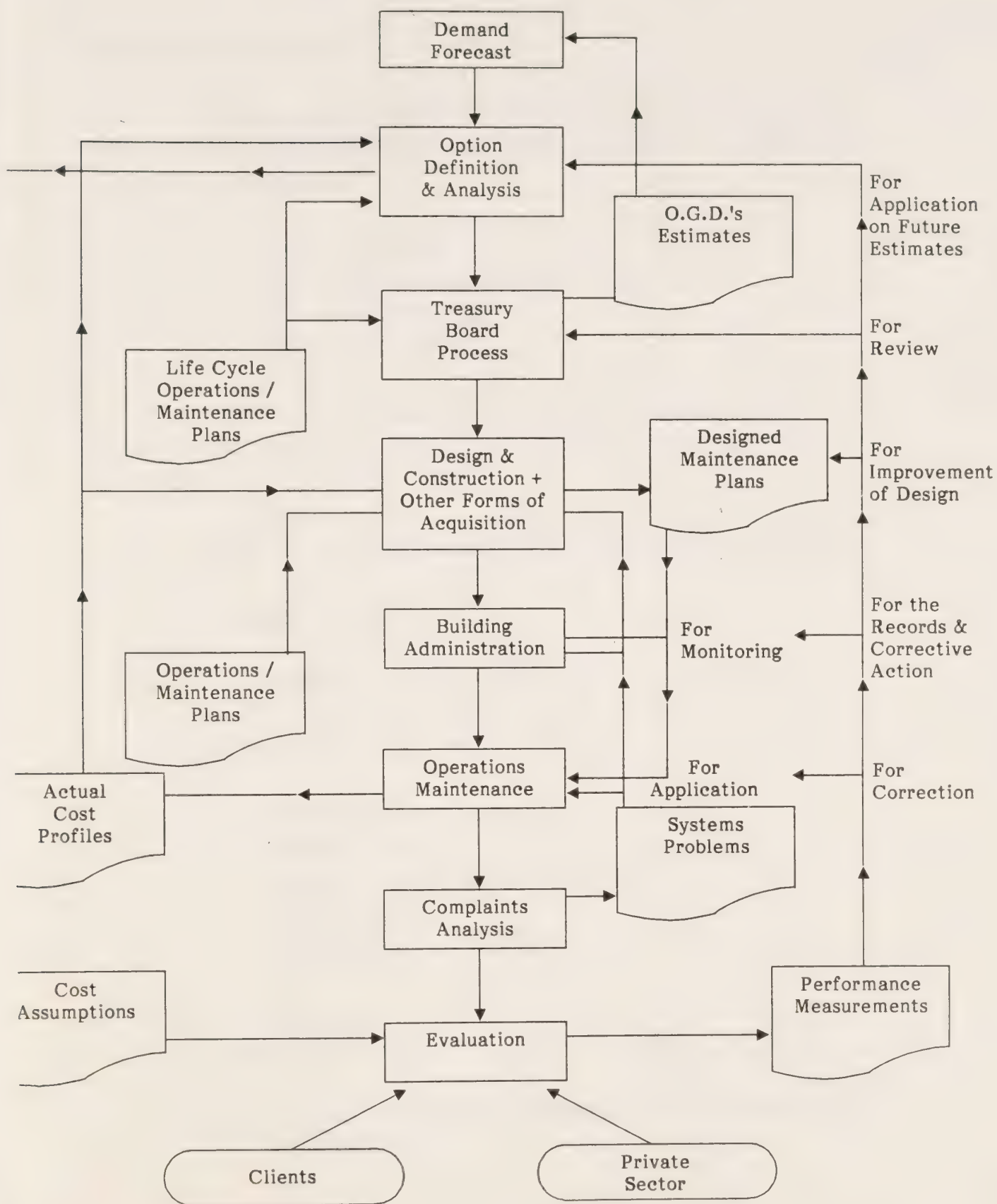
By matching controls with possible effects, we can narrow the focus of our examination. What we are actually saying is that the weakness or absence of option definition and analysis control function will likely lead, albeit indirectly, to any or all of the following:

- (a) Actual asset cost will be excessive.
- (b) Operations and maintenance will be excessive.
- (c) Revenue will be lower than acceptable level.
- (d) User needs will not be met.

In addition, these potential consequences add up to make this control point a key one that merits our attention. And so on for other control-consequence relationships.

We shall now concentrate on the economy issue. In particular, we shall examine the possible excessive cost of acquiring the asset. We want to find out which management control function permits this adverse effect. Is it poor forecasting of demand? Is it weak option definition and analysis? Is the Treasury Board process to blame? Or is the phase of design and construction at the root of the problem? Of course it is possible that a combination of the above, or indeed matters beyond the management process, are causes of the suspected adverse effect.

Past experience shows that diseconomy in capital acquisitions could be the result of a number of things. To be on the safe side, we will look at all key controls shown by the matrix to have an impact on this economy issue.



Specifying Audit Criteria

Let us say the Department could reasonably be expected to acquire capital assets at economical costs if the following key controls or systems exist and function adequately:

- Demand Forecast;
- Option Definition and Analysis;
- Treasury Board Process;
- Design and Construction.

However, we need to identify audit criteria for each of these key systems or control functions. The audit criteria will be used as standards for evaluating managerial actions.

We state these criteria by saying: There should exist the following:

(a) Forecast of Demand

- reliable forecast of demand;

(b) Option Definition and Analysis

- accurate data;
- life-cycle costing;
- accurate cost of financing calculation;
- revenue estimates;
- proper analysis of alternatives;
- etc.;

(c) Treasury Board Process

- requests for funds to be supported by accurate and complete documentation;
- etc.;

(d) Design and Construction

- competent architects;
- appropriate design changes control;
- adequate project cost control;
- etc.

Having done his or her home work and narrowed the focus, the auditor begins to look deeper into those four control functions.

Result of Preliminary Survey

The auditor should be able to provide a preliminary assessment of the system and key controls. Such an evaluation could be presented in the format of Potential Finding Sheets (Exhibits 1, 2, 3 and 4). They represent tentative conclusions concerning each key control function. Each sheet has the following components:

Component	Significance	Source/Reference
● Title	To identify control function under examination.	Matrix
● Hypothesis	Tentative conclusion	Matrix
● Criteria	Standard for evaluating managerial actions.	● OAG
● Condition	What was found through preliminary survey or organization and systems.	● Logic ● System descriptions ● Decision process descriptions
● Effect	What could go wrong - matters of significance	● Auditor's interpretation of AG mandate ● Matrix to a limited extent
● Cause	To enable auditor to make constructive recommendations	● Auditor's judgement and experience ● Speculation ● Preliminary Survey
● Recommendation	For constructive auditing	● Auditor's judgement

It may be helpful to be more specific on the sources/references for the potential causes listed above by including:

- knowledge of the business, client and past history;
- observation;
- enquiry and confirmation;
- inspection of documents;
- computations; and
- analysis.

POTENTIAL FINDING NO. 1

Title:	Demand Forecast
Hypothesis:	Cost of asset is likely to be excessive. When unable to forecast demand reliably, the Department tends to provide bigger and costlier buildings.
Criteria:	There should be a reliable forecast of demand.
Condition:	<ul style="list-style-type: none">- Department cannot possibly control key factors in accommodation demand.- No clear definition of responsibility and accountability.- Almost impossible to forecast reliably the government need for office accommodation.- Lack of clearly described, written objectives noted in past procedures.- Etc.
Effect:	Possible excessive cost of asset.
Cause:	(Not identified).
Recommendation:	(Not yet made).

POTENTIAL FINDING NO. 2

Title:	Option Definition and Analysis.
Hypothesis:	Cost of asset excessive.
Criteria:	<p>There should be a comprehensive option definition and analysis including:</p> <ul style="list-style-type: none">- accurate data;- life-cycle costing;- accurate cost of financing calculation;- precise revenue estimates;- proper analysis of alternatives;- etc.
Condition:	<ul style="list-style-type: none">- Quality of information used as input into the computer-based investment model is poor.- Life-cycle costing omitted.- Cost of financing calculations inaccurate.- Revenue estimates imprecise.- Alternatives not properly analysed.
Effect:	Possible excessive cost of asset.
Cause:	Advocacy and uncritical acceptance of costly methods of acquisition (lack of objectivity).
Recommendation:	(Not made yet - but could be made in management letter - eliminate condition and comply with criteria).

POTENTIAL FINDING NO. 3

Title:	Treasury Board Process.
Hypothesis:	Non-compliance with TB Process may result in excessive cost of asset.
Criteria:	<p>These should be adequate control by TB over DPW's expenditures including:</p> <ul style="list-style-type: none">- requests for funds should be supported by accurate and complete documentation;- etc.
Condition:	<ul style="list-style-type: none">- Life-cycle costing not presented to TB.- Chosen alternatives presented as the most economical.- Inflation not accurately anticipated.- No detailed examination by TB.- Etc.
Effect:	Possible excessive cost of asset.
Cause:	ADM's wish to present his plans to TB as the best ones (human nature: wish to be right).
Recommendation:	(Not made yet - but could be made in management letter - eliminate condition and comply with criteria.)

Title: Design and Construction.

Hypothesis: Design changes and weak project cost control will likely lead to excessive cost of asset.

Criteria: There should be:

- competent architects;
- no substantial design changes without approval by TB;
- adequate project cost control;
- etc.

Condition: Substantial design changes are allowed by TB.

Effect: Excessive cost of asset.

Cause: (Not identified yet).

Recommendation: (Not made yet).

Preparing Audit Plan

The results of the preliminary evaluation indicate weaknesses in all four controls.

The objective for the audit plan should now be clear: To illustrate to the auditee's management the extent of dollar costs that could occur as a result of deficiencies in the management process. By illustrating, at the survey phase, the possible cost effect resulting from weaknesses in the management process, our potential recommendations will be difficult to refute.

How to establish satisfactory audit evidence of the non-existence of significant controls in the management process is, among other things, a sampling problem familiar to auditors and will not be discussed here. Let us assume that:

(a) The auditor planned to examine:

- a project in the planning stage;
- a partially constructed building;
- a building that has just been completed;
- a building that has been completed for a number of years.

(b) The auditor's resources were:

Staffing:

- a CA;
- an MBA;
- an architect.

Advisers:

- quality assurance/challenge edit;

- lawyer;
 - commercial lessor.
- (c) The results of examining one project (C.D. Howe Building) are now available.

Substantive Test Results

The results of substantive tests of C.D. Howe Building showed the following adverse effects:¹.

- Cost of project reached \$102 million compared to planned and approved cost of \$57 million.
- The method used to acquire the building cost approximately \$12 million more than an alternative method of acquisition.

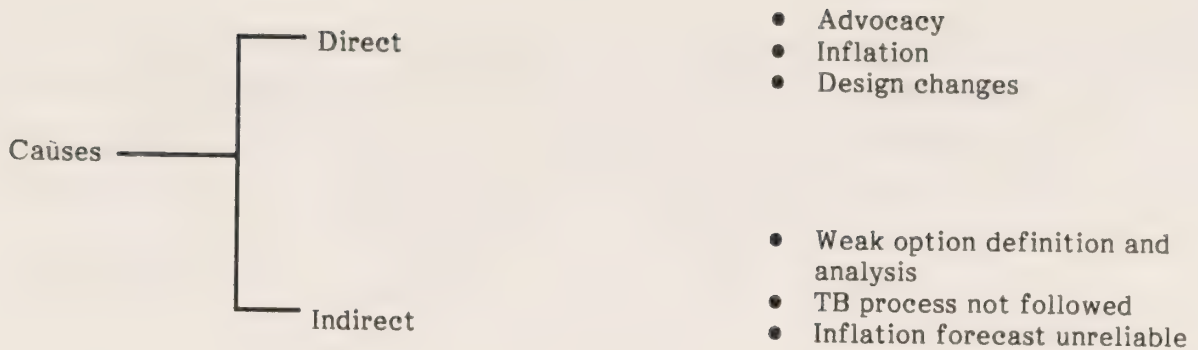
Cause-Effect Analysis

With reference to our tentative conclusions and all other further evidence, we have a better understanding of the causal complex (Figure 4). For example, we find out that design changes are the personal choice of the project architect. We also recognize that management process did not allow for reliable forecasting of inflation, and that inflation was actually high during the construction period.

We obtained sufficient appropriate evidence that enabled us to eliminate other potential causes for excessive cost, such as strikes, collapsing components of the building during construction due to poor design, poor materials or poor construction work, and so on².

In fact, we may break down causes into direct and indirect as follows:

-
1. See 1978 AG Report p. 52
 2. Demonstrating how the logic was worked out and evidence obtained is beyond the scope of this paper.



We also note that most indirect causes are related to the management process. We now have significant data to be inserted in the matrix (Exhibit 5).

When we think of cause we think of the origin, source, prime mover or reason that leads to or produces the effect. In other words, it should answer the question "Why did it happen?"

We may now attribute causes to effects although a separation may not always be possible. For example, we may be able to say that the management system and practices allowed the ADM to choose an outside contractor that, in turn, led to the \$12 million in extra costs. Similarly, we may be able to say that the state of the economy led to inflation which, in turn, led to increased costs from planned. Finally, the choice of the project architect, compiled with allowing substantial design changes, also caused increased costs from planned.

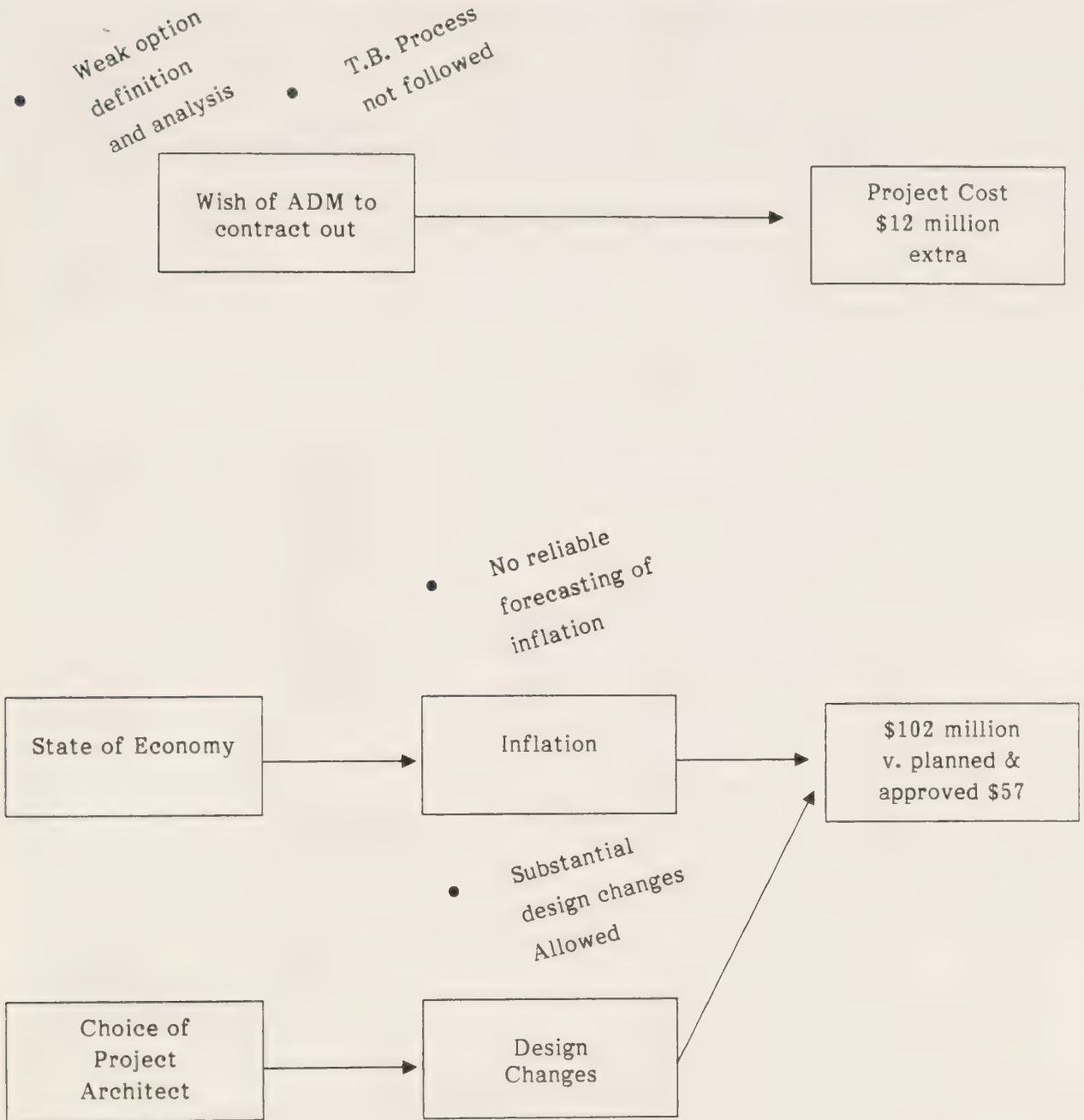
The distinction between direct causes and indirect causes is an important concept. Indirect causes are the underlying circumstances that permit the direct cause to operate.

Often we are more concerned with the underlying circumstances than with direct causes. The reason for this is practical. Direct causes are frequently laws of nature (accidents, history, human nature, etc.). Most interferences with laws of nature are ineffective or prohibitively costly. However, we are able to minimize the chances for the direct causes to operate by eliminating the underlying circumstances. For example, the uncritical advocacy of costly

projects by a senior public servant, for which audit evidence was obtained, has roots in understanding human behaviour. Rather than attempting to change human behaviour (the direct cause), we could prevent the unwanted effect by insisting that alternative methods of asset acquisition be fully examined. Very few public servants will actually choose the more expensive alternative if they have full information. We could also recommend that an independent party examine the proposals with a critical mind, having obtained full information (e.g., Treasury Board).

Figure 4

FIGURE 4: CAUSAL COMPLEX FOR EXCESSIVE COST OF PROJECT



WEAK CONTROL FUNCTIONS	Actual Adverse Effects		
	Excessive Cost-Asset	Unauthorized Expenditures	Others
<ul style="list-style-type: none"> • Demand Forecast 			
<ul style="list-style-type: none"> • Option Definition and Analysis 	<ul style="list-style-type: none"> • \$12 million more than an alternative method of acquisition 		
<ul style="list-style-type: none"> • Treasury Board Process 	<ul style="list-style-type: none"> • \$12 million more than an alternative method • \$102 million v. planned \$57 	<ul style="list-style-type: none"> • \$102 million v. approved \$57 	
<ul style="list-style-type: none"> • Design and Construction 	<ul style="list-style-type: none"> • \$102 million v. planned \$57 		
<ul style="list-style-type: none"> • Others 			

Developing Observations and Recommendations

The audit finding which emerges may be presented as in Exhibit 6. The information sources are detailed below.

Although knowing the causes facilitates our task, our recommendations are more effective if we concentrate on eliminating the conditions, since they relate more closely to management processes and systems.

<u>Audit Observation Component</u>	<u>Source</u>
Title	Matrix
Criteria	OAG
Condition	<ul style="list-style-type: none">● Logic models● System descriptions● Decision process description● Result of examination
Effect	Result of examination
Cause	<ul style="list-style-type: none">● Result of examination● Judgement and experience
Recommendation	Judgement and experience
<hr/>	
Cause-effect relationship	Judgement and experience
Condition-effect relationship	Matrix

Conclusion

To prove conclusively that an adverse effect is attributable to a particular weakness in a management control function requires extensive, costly and rigorous testing. Even then the results will most likely show that other management controls are involved. Indeed, matters beyond the control of management often cause such adverse effects to happen.

AUDIT OBSERVATION

No due regard to economy in acquiring the
C.D. Howe Building.

Criteria:

- As in Exhibit 2.
- As in Exhibit 3.
- As in Exhibit 4.

Condition:

- Weak option definition and analysis.
- TB process not followed.
- No reliable forecasting of inflation.
- Substantial design changes are allowed after project approval.

Effects:

- Project cost \$12 million more than an alternative method of acquisition.
- Cost of project is \$102 million compared to planned and approved \$57 million.

Causes:

- Wish of ADM to contract out rather than have DPW construct the building.
- Inflation.
- Wish of project architect to make major design changes.

Recommendations: (Specified to eliminate conditions and comply
with criteria).

In addition, a weakness in that particular control in the management process will most likely produce more than one adverse effect. Again, to prove this requires extensive, costly testing.

Since the management process consists of many systems, sub-systems and controls, a systematic approach should be developed for planning the audit tests efficiently.

Furthermore, the thrust of our audit efforts should be directed towards the results and seeking causes of deficiencies in those results. The audit is not served by identifying deficiencies in causes, such as deficiencies in some control, calling them results and then proceeding to speculate about the causes in the deficiencies of causes!

Recommendations

As an aid for identifying key controls and their relationships to significant effects, the use of a matrix is recommended. We found that the approach described in this paper amplified the audit rationale at the following stages of the comprehensive audit process:

1. Identifying significant systems and key controls.
2. Conducting the preliminary evaluation of systems and key controls.
3. Determining causes and effects for unsatisfactory systems.
4. Developing conclusions and recommendations.

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